DOCUMENT RESUME

ED 338 360 PS 019 908

AUTHOR Dukette, Dianne; Stiles, Joan
TITLE The Early Development of Children's Ability To Analyze Hierarchical Patterns and Reproduce Them from Memory.
PUB DATE Apr 91
NOTE 11p.; Paper presented at the Biennial Meeting of the Society for Research in Child Development (Seattle, WA, April 18-20, 1991).
PUB TYPE Speeches/Conference Papers (150) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Adults; Age Differences; Developmental Stages; Early Childhood Education; Freehand Drawing; *Memory; Visualization; *Visual Measures; *Visual Perception; *Young Children
IDENTIFIERS *Analytic Ability; *Pattern Drawing Test

ABSTRACT

Previous literature on children's visual pattern perception has suggested that preschool children may process hierarchical forms in a manner different from that of older children and adults. Data from some studies suggested that children are holistic processors of pattern information, while other studies characterized children as piecemeal processors. In this study, 4-, 5-, 6-, and 8-year-olds and adults were asked to draw four different hierarchical stimuli, two composed of letters and two of geometric forms. In the memory condition, each stimulus was presented for 5 seconds and then removed from view. The subject was then asked to draw it. This procedure continued until all four forms had been drawn. The control condition was identical, except that each model remained in view until the subject was finished drawing it. Results indicated that, contrary to earlier reports in the literature, younger children, like the older children, reproduced the global and local levels of the hierarchical forms with equal facility in both the copy condition and the memory condition. Four figures showing the reproduction task stimuli, the scoring scales, scores of drawing quality in memory and control conditions, and actual drawings of subjects are appended. (Author/GLR)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

ED338360

The Early Development of Children's Ability to Analyze Hierarchical Patterns and Reproduce Them From Memory

Dianne Dukette and Joan Stiles
University of California, San Diego

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Dianne Dukette

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

PS 019908

Paper presented at the biennial meeting of the Society for Research in Child Development. April, 1991: Seattle, Washington

BEST COPY AVAILABLE

ABSTRACT

Previous literature on children's visual pattern perception has suggested that preschool children may process hierarchical forms differently from older children and adults. Data from some studies suggested that children are holistic processors of pattern information while other studies characterized children as piecemeal processors. In the present study, 4-, 5-, 6-, and 8-year old children and adults were asked to draw a total of four different hierarchical stimuli, two composed of letters and two of geometric forms. In the memory condition, each model was presented for 5 secs. and then removed from view. The subject was then asked to draw it. This procedure continued until all four forms had been drawn. The control condition was identical except that each model remained in view until the subject was finished drawing it. Results suggested that, contrary to earlier reports in the literature, younger children, like the older subjects, reproduced the global and local levels of these hierarchical forms with equal facility in both the copy condition, and in the more demanding memory condition.

INTRODUCTION

Previous studies have suggested that young children's processing of complex visually presented spatial patterns is different from that of adults. Although these studies differed in their specific characterizations of children's processing, the general conclusion was that preschool and early school age children demonstrated very limited analytic abilities (Corah & Gospodinoff, 1966; Carey & Diamond, 1977; Dworetzki, 1939; Elkind, Koegler & Go, 1964; Gibson 1969; Vurpillot, 1976; Werner 1948). Recently, Kemler Nelson and others, (Kemler, 1983; Kemler Nelson, 1984, 1988, 1989; Shepp, 1988; Shepp & Swartz, 1976; Smith & Kemler, 1977), have also presented data suggesting that young children do not attend to separate dimensions or features, but rather treat the stimulus patterns as unanalyzed wholes. They suggest, therefore that young children's perceptual processing is best described as holistic. Based on these findings, it has been proposed that development consists of a shift from a predominantly holistic mode of processing to one that is primarily analytic.

However, work from our laboratory has suggested that even very young children process spatial aspects of stimulus arrays analytically. In an earlier study, we used hierarchical forms in which smaller, "local" level letters were positioned to form a larger "global" level letter. Hierarchical stimuli allow for experimental control in equating the global and local levels of each form for factors such as familiarity, complexity, and information type. In a forced-choice similarity matching task we found that children as young as age 4 were readily able to use information from both the global and local levels of the hierarchical letter forms to make similarity judgements. This suggests, at minimum, early and significant flexibility in shifting attention between the global and local levels of the stimulus patterns.

In order to elaborate and extend our previous findings, the present study was designed to investigate whether children's facility with different levels of the pattern hierarchy would be maintained under more demanding task conditions. For this study, a reproduction task was developed. In this task, subjects were asked to draw hierarchical forms from memory. If younger children were able to reproduce information from both the global and local levels of the forms with equal facility, this finding would provide a further indication of their analytic competence.

METHOD

Subjects. A total of 50 subjects, 10 adults and 40 children, participated in this study. The children were divided into four groups of 10 including 4-, 5-, 6-, and 8-year-olds.

Stimuli. There were four hierarchical patterns, two composed of letters and two of geometric forms. For each of these stimuli, the smaller, local level elements (0.4 cm. x 0.3 cm.) were positioned in a 5 x 7 matrix to form the larger, global level form (3.7 cm x 2.5 cm). (See Figure 1). In addition, two sets of control stimuli were designed for use in a memory version only. These were simple, non-hierarchical letter and geometric forms. One set was used to assess any differential effect of stimulus size on performance and the other to evaluate the difficulty of reproducing two forms from memory.

Procedure. Each hierarchical stimulus was presented individually, one at a time, in two conditions, memory and control. In the first condition, memory, the subject was presented with the first model pattern for 5 seconds after which time it was removed. The subject was then asked to draw this model from memory. This continued until the subject had seen and drawn all four stimulus patterns in turn. The last condition was the control. This condition was identical to the memory condition except that each model remained in view while the subject copied it.

Scoring. Two independent raters scored the quality of all drawings. The quality of the global and local level of each drawing was scored separately using two different comparable six point ordinal scales, so that each drawing received two scores, one for each level (See Figure 2). For example, the lowest score, a "0", would be assigned to either the global or the local level if the form on that level was either unrecognizable or absent. The highest score, a "5", for the global level would mean that the global form was correct, appropriately configured, correctly oriented, and that the correct number of elements were present and appropriately spaced. A score of "5" would be assigned for the local level if all elements were present, accurate, correctly oriented and very well drawn. This scoring system was validated in a separate "copy only" study in which it was confirmed that the global and local scales were comparable at every level.

RESULTS AND DISCUSSION

All subjects, including the 4-year-olds, reproduced information equally well from both the global and local levels of the hierarchical forms. This was true even in the memory condition, which was, as predicted, more difficult for subjects of all ages. Of course, there was an age related improvement in general drawing quality, but improvement did not selectively effect the global or the local level. Figure 3 shows the effects graph of Age, Condition, and Pattern Level. Although this 3-way interaction was not significant, it best illustrates the major findings of the study.

The data from this study were analyzed in a 4 x 2 x 2 x 2 x 2 x 2 mixed design analysis of variance (ANOVA). Age (4-, 5-, 6-, 8-year-olds and adults), Gender, and Order were the between subjects factors. Condition (Memory and Control), Form Type (Letter and Geometric) and Pattern Level (Global and Local) were the within subjects factors. There were no significant effects of Gender or Order; these factors were therefore eliminated from the analysis. There was a main effect of Age, $F(1,40) = 123.13$, $p<.01$, and of Condition, $F(1,40) = 47.16$, $p<.01$. There was no effect of Form Type, (letter or geometric), or of Pattern Level (global or local). There were no significant interactions.

In summary, as would be expected, drawing quality in both the memory and control conditions improved with age (See Figure 4). All subjects were also better at reproducing the hierarchical forms in the control condition, where the model remained in view, than they were when drawing them from memory. The important finding concerns the comparability of children's reproductions of the global and local pattern levels, which is evident even among the 4-year-olds.

These reproduction data support and extend our earlier findings that young children regularly demonstrate some analytic competence.

Figure 1

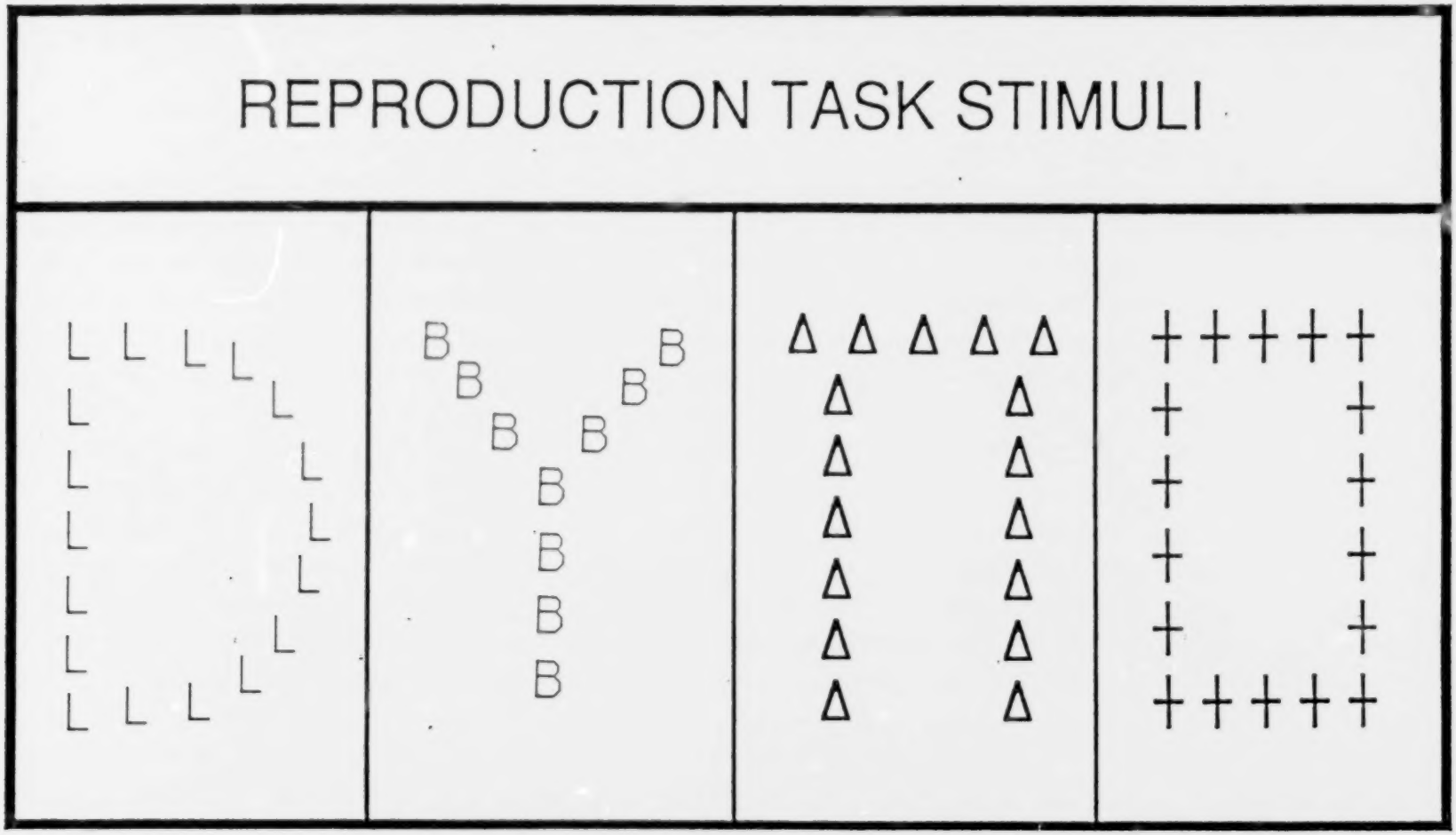
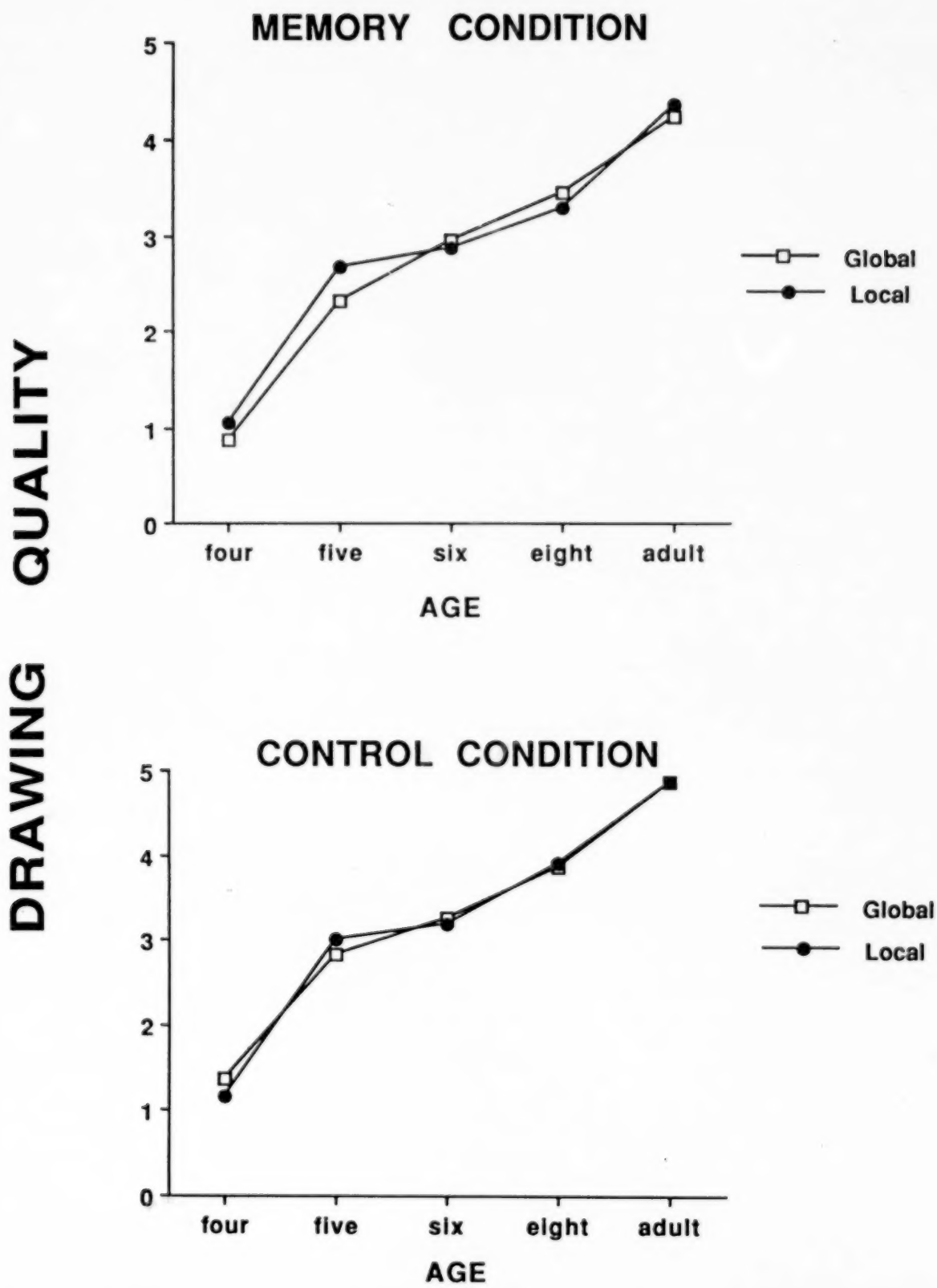


Figure 2

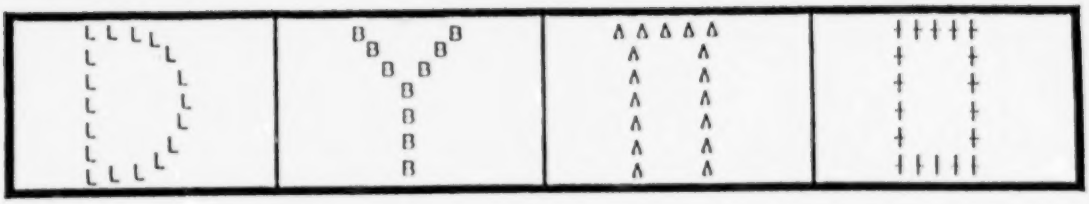
SCORING SCALES

GLOBAL	LOCAL
+ 0 -UNRECOGNIZABLE -SCRIBBLE -RANDOM LOCAL ELEMENTS	+ 0 -UNRECOGNIZABLE -SCRIBBLE -ONLY GLOBAL FORM
+ 1 -RECOGNIZABLE BUT WRONG CONFIGURAL OR NON-CONFIGURAL FORM	+ 1 -RECOGNIZABLE BUT WRONG -ATTEMPT TO INDICATE "ELEMENTS"
+ 2 -CORRECT GLOBAL FORM BUT NOT CONFIGURAL	+ 2 -AT LEAST SOME OF THE FORMS ARE RECOGNIZABLE AND ACCURATE
+ 3 -CORRECT CONFIGURAL FORM -SPACING DISTORTIONS -ONLY ADEQUATELY DRAWN	+ 3 -ALL FORMS RECOGNIZABLE -AT LEAST 50% ACCURATE -ORIENTATION PROBLEMS
+ 4 -CORRECT FORM AND SPACING -TWO ELEMENTS MAY TOUCH	+ 4 -ALL FORMS CORRECT -CORRECT SPACING -GOOD ORIENTATION
+ 5 -FORM IS EXCELLENT -CORRECT# OF LOCAL FORMS -CORRECT ORIENTATION	+ 5 -FORMS ARE EXCELLENT -CORRECT# OF LOCAL FORMS -CORRECT ORIENTATION

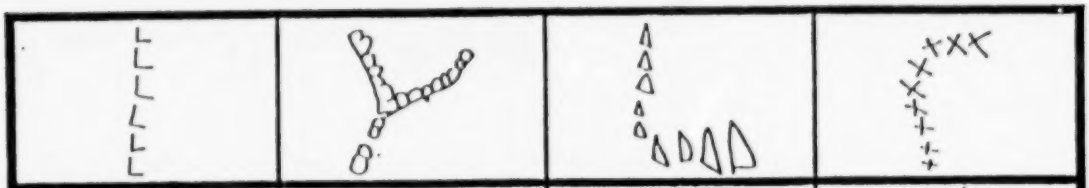
Figure 3


MEMORY CONDITION
DRAWING QUALITY
5
4
3
2
1
0
four
five
six
eight
adult
AGE
Global
Local
CONTROL CONDITION
5
4
3
2
1
0
four
five
six
eight
adult
AGE
Global
Local

MODEL



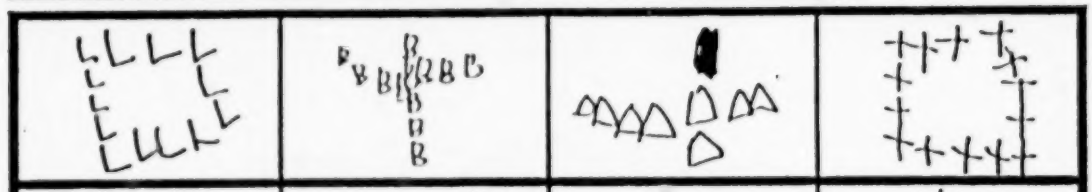
MEMORY



4

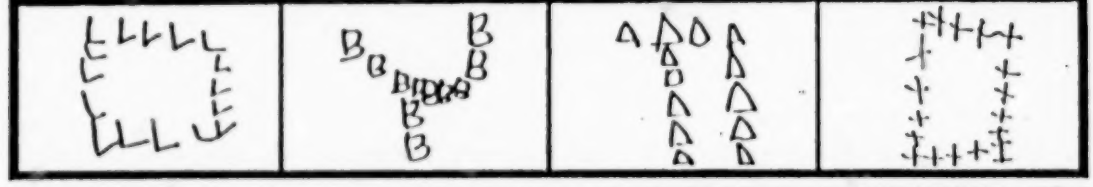
COPY

MEMORY

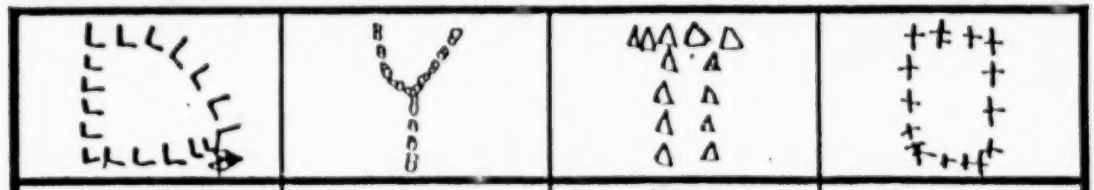


5

COPY



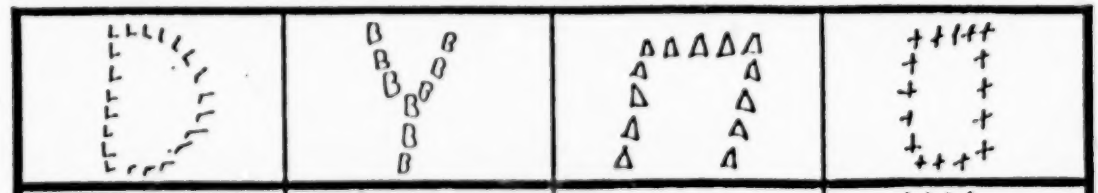
MEMORY



6

COPY

MEMORY



8

COPY